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EXAMINER

RUGGLES, JOHN S

ART UNIT	PAPER NUMBER
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1756

DATE MAILED: 07/28/2003

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Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/050,484

Applicant(s)

RANGARAJAN ET AL.

Examiner

John Ruggles

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 05 March 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-24 is/are pending in the application.
- 4a) Of the above claim(s) 1-8 and 20-24 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 9-19 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☒ Claim(s) 1-24 are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 16 January 2002 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

## **DETAILED ACTION**

### ***Election/Restrictions***

Restriction to one of the following inventions is required under 35 U.S.C. 121:

- I. Claims 1-8, drawn to a semiconductor structure, classified in class 430, subclass 271.1.
- II. Claims 9-19, drawn to a method of processing a semiconductor structure and a method of increasing adhesion, classified in class 430, subclass 311.
- III. Claims 20-24, drawn to a system (apparatus) for semiconductor processing (coating) and monitoring, classified in class 118, subclass 665.

Inventions I and II are related as product and process of use. The inventions can be shown to be distinct if either or both of the following can be shown: (1) the process for using the product as claimed can be practiced with another materially different product or (2) the product as claimed can be used in a materially different process of using that product (MPEP § 806.05(h)). In the instant case, the product as claimed can be used in a materially different process, such as selective scribing and etching.

Inventions II and III are related as process and apparatus for its practice. The inventions are distinct if it can be shown that either: (1) the process as claimed can be practiced by another materially different apparatus or by hand, or (2) the apparatus as claimed can be used to practice another and materially different process. (MPEP § 806.05(e)). In this case, the process as claimed can be practiced by another materially different apparatus, such as a projection exposure apparatus not having monitoring or measuring means for coating thickness.

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Inventions III and I are related as apparatus and product made. The inventions in this relationship are distinct if either or both of the following can be shown: (1) that the apparatus as claimed is not an obvious apparatus for making the product and the apparatus can be used for making a different product or (2) that the product as claimed can be made by another and materially different apparatus (MPEP § 806.05(g)). In this case, the product as claimed can be made by another and materially different apparatus, such as a coating apparatus not having monitoring or measuring means for coating thickness.

Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

During a telephone conversation with Gregory Turocy on 24 June 2003 a provisional election was made with traverse to prosecute the invention of Group II, claims 9-19. Affirmation of this election must be made by applicant in replying to this Office action. Claims 1-8 and 20-24 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to non-elected inventions.

Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

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### *Specification*

Applicant is reminded of the proper language and format for an abstract of the disclosure.

The abstract should be in narrative form and generally limited to a single paragraph on a separate sheet within the range of 50 to 150 words. It is important that the abstract not exceed 150 words in length since the space provided for the abstract on the computer tape used by the printer is limited. The form and legal phraseology often used in patent claims, such as "means" and "said," should be avoided. The abstract should describe the disclosure sufficiently to assist readers in deciding whether there is a need for consulting the full patent text for details.

The language should be clear and concise and should not repeat information given in the title. It should avoid using phrases which can be implied, such as, "The disclosure concerns," "The disclosure defined by this invention," "The disclosure describes," etc.

The abstract of the disclosure is objected to because it has more than 150 words.

Correction is required. See MPEP § 608.01(b).

35 U.S.C. 112, first paragraph, requires the specification to be written in "full, clear, concise, and exact terms." The specification is replete with terms that are not clear, concise and exact. The specification should be revised carefully in order to comply with 35 U.S.C. 112, first paragraph. Examples of some unclear, inexact or verbose terms used in the specification are: (1) it is unclear what compound(s) are intended by "1,4-oxathialan-2-one" and "4,4-dioxide", found at lines 17-18 on page 5 (please clarify whether or not they were intended to be combined into a single chemical compound, e.g., --1,4-oxathian-2-one-4,4-dioxide--, --1,4-oxathiolan-2-one-4,4-dioxide--, etc.); (2) also on page 18, at line 19, --polyethylene dioxide-- is misspelled; and (3) the phrase "containing from about one to about carbon atoms" found at line 11 on page 6 is incomplete and must be corrected in accordance with the original disclosure. Note that due to the number of errors, those listed here are merely *examples* of the changes required in the specification and do not represent an exhaustive list thereof.

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Appropriate correction is required. An amendment filed making all appropriate corrections must be accompanied by a statement that it contains no new matter.

***Claim Rejections - 35 USC § 112***

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 11 and 17 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. It is unclear what chemical compound(s) were intended by the terms "1,4-oxathialan-2-one" and "4,4-dioxide" found in the last line of both claims 11 and 17. Applicant must clarify whether or not these terms were intended to represent a single compound (e.g., --1,4-oxathian-2-one-4,4-dioxide--, --1,4-oxathiolan-2-one-4,4-dioxide--, etc.).

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 9-10 and 15-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Krounbi, et al. (US Patent 5,604,073).

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Krounbi teaches that use of a bi-layer resist lift-off process is well known in the art for making thin film structures such as integrated circuit components and field effect transistors (FET, column 1, lines 17-21). The process is known to include coating a release layer or coupling agent such as polydimethylglutarimide (PMGI) on a suitable substrate, which is understood to include a semiconductor substrate. The PMGI layer is then covered with a positive resist (diazonaphthoquinone/novolac). This is followed by patterned exposure and developing of the resist and then the PMGI to remove the exposed areas of both layers (column 1, lines 27-39). Good adhesion of PMGI to various substrates have been obtained by oven baking at 190-290 °C (column 1, lines 43-46) but are greatly improved without high temperature baking by addition of azo dyes (column 2, lines 53-56). This results in increased adhesion between subsequently applied resist and the underlying substrate, as well as improving removal of exposed areas of both layers during developing. As stated at column 2, lines 23-26, bi-layer lift-off processes are known in the art to produce well-defined patterns when combined with subsequent deposition through the bi-layer resist pattern. A PMGI thickness of 1,000 Å on a wafer substrate was found suitable for subsequent deposition and lift-off (column 3, lines 11-14).

While teaching the exposure and removal of exposed PMGI and resist during developing, Krounbi does not specifically teach that the PMGI coupling agent is light degradable and does not require that the PMGI be at least partially decomposed during exposure of the overlying resist.

However, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have carried out the exposure of both the resist and the PMGI coupling agent in a single step, so that exposure light penetrated not only through the overlying resist, but

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also into the PMGI layer to simplify the process. This is because PMGI is believed to be light degradable due to the presence of side chain ketone groups in this polymer.

Claims 12-14 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Krounbi in view of Guillet (US Patent 3,811,931).

While teaching a bi-layer resist photolithography process using a light-degradable surface coupling agent (PMGI) under the resist, Krounbi does not specify that the surface coupling agent has ketone side chain groups as shown in instant claims 12 and 19.

Guillet shows ultraviolet (UV) degradable coatings made from a polymer or copolymer having side chain ketone carbonyl groups, which are attached to carbon atoms immediately adjacent to the polymer backbone chain, as shown in instant claims 12 and 19 (column 3, line 55 to column 4, line 5). When a coating of cured resin having these ketone carbonyl side chain groups is exposed to UV, the ketone carbonyl groups absorb the UV and scission of the resin backbone occurs adjacent to the ketone carbonyl groups. Each scission is equivalent to breaking a cross-link to reverse the curing process, resulting in increased water permeability and solubility (column 2, lines 53-64). All polymers containing this ketone carbonyl linkage are expected to also degrade quite rapidly when exposed to UV (column 5, lines 56-59). Higher concentrations of ketone carbonyl groups in the polymer result in faster degradation and UV can still penetrate thinner films having higher concentrations of ketone carbonyl groups. 90% absorption in the coating was observed for (1) a 1.0 cm coating thickness having 0.5 mole % ketone carbonyl and (2) a 0.1 cm coating thickness having 5.5 mole % ketone carbonyl (column 6, lines 1-23).



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It would have been obvious to one of ordinary skill in the art at the time the invention was made to have substituted the light degradable polymers having ketone carbonyl groups as shown by Guillet for the PMGI light degradable coupling agent for improving resist adhesion to a semiconductor substrate as taught by Krounbi. This is because both PMGI and the light degradable polymers shown by Guillet have side chain ketone carbonyl groups for absorption of UV to cause chain scission, which is expected to result in increased water permeability and solubility of the exposed regions. It would also have been obvious to have decreased the light degradable coupling agent film thickness to less than half of the 1,000 Å shown by Krounbi for PMGI (to less than 500 Å) with the expectation of doubling the concentration of ketone carbonyl groups in the coupling agent which would further increase the speed of degradation of the coupling agent in the exposed regions.

Claims 11 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Krounbi in view of Guillet and further in view of Bonsignore, et al. (US Patent 5,563,238).

While teaching a bi-layer resist photolithography process using a light-degradable surface coupling agent (PMGI) under the resist, Krounbi does not specify that the surface coupling agent be a polymer of lactic acid.

Bonsignore describes a UV light degradable copolymer from monomers of lactic acid and a modifying monomer selected from the class consisting of ethylene glycol, propylene glycol, p-dioxanone, 1,5-dioxepan-2-one, 1,4-oxathialan-2-one-4,4-dioxide, and mixtures thereof. This copolymer is suitable for UV light degradable films (abstract, column 2, lines 21-44). It is noted that the last listed compound is also shown as "1,4-oxathia-2-one-4,4-dioxide" in claims 1, 6, and

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10 (column 5, lines 41-42, column 6, lines 13 and 34). Polymers and copolymers of lactic acid are transparent and colorless thermoplastics with a wide range of physical properties that mimic those of many conventional thermoplastics and the degradation rate varies from fast to slow depending on the amounts of polylactic acid or polyglycolic acid utilized (column 2, line 66 to column 3, line 25). The degradation rate and other physical properties of the copolymer can be further controlled by the various modifying monomers used in the copolymer (column 4, lines 23-28). It is further noted that lactic acid and all of the modifying monomers listed have at least one ketone group (having an oxygen atom double bonded to a carbon atom, C=O).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have substituted the light degradable polymers or copolymers made from monomers having ketone groups as shown by Bonsignore for the PMGI light degradable coupling agent for improving resist adhesion to a semiconductor substrate as taught by Krounbi. This is because both PMGI and the monomers from which the light degradable copolymers shown by Bonsignore were made have ketone groups for absorption of UV and would be expected to degrade by chain scission at the ketone groups as shown by Guillet and discussed above.

Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Krounbi in view of Guillet and further in view of Henry (US Patent 3,676,401).

While teaching a bi-layer resist photolithography process using a light-degradable surface coupling agent (PMGI) under the resist, Krounbi does not specify that the surface coupling agent be a mixture of a polymer with an organometallic compound or a metal salt in which the polymer is a polyolefin or a polyvinyl alcohol.

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Henry teaches a light degradable coating composition comprising (1) a copolymer of ethylene and carbon monoxide and (2) a UV light degradable amount of an organometallic compound or a metal salt (e.g., ferricine, cobalt acetyl acetate, etc., abstract). Even more generally, polyolefins are also quite susceptible to UV light degradation by rapid embrittlement and cracking with ultimate decomposition (column 2, lines 12-16). Additionally, polyvinyl alcohol films are also light degradable (column 3, lines 10-17). The degrading effect of UV light on such polymers or copolymers can be accelerated by addition of an organometallic compound (e.g., ferricine, etc.) or by blending in of a metal salt with the polymer or copolymer to cause faster oxidation when exposed to UV (column 3, lines 45-50). The same equipment used for conventional thermoplastics can also be used to process these UV light degradable polymers or copolymers (column 5, lines 50-68). Furthermore, it is noted that several of the metal salts or organometallic compounds usable as degradation accelerators (e.g., metal acetylacetonates, metal alkylacetoacetates, etc., column 4, lines 28-40) for these polymers or copolymers have at least one ketone group (having an oxygen atom double bonded to a carbon atom,  $C=O$ ).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have substituted the light degradable polymers or copolymers made with organometallic compounds or metal salts having ketone groups as shown by Henry for the PMGI light degradable coupling agent for improving resist adhesion to a semiconductor substrate as taught by Krounbi. This is because both PMGI and several of the light degradation accelerators (organometallic compounds or metal salts) in the polymer or copolymer coating compositions taught by Henry have ketone groups for absorption of UV and would be expected to degrade by

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chain scission promoted by the light degradation accelerator ketone groups as shown by Guillet and discussed above.

***Conclusion***


Any inquiry concerning this communication or earlier communications from the examiner should be directed to John Ruggles whose telephone number is 703-305-7035. The examiner can normally be reached on Monday-Thursday and alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 703-308-2464. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.



MARK F. HUFF  
SUPERVISORY PATENT EXAMINER  
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John Ruggles  
Examiner  
Art Unit 1756